BIRDS OF THE SIERRA DE TUXTLA IN VERACRUZ, MEXICO

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The Sierra de Tuxtla is a small mountain range which forms an isolated topographic uplift from the nearly level Gulf coastal plain of southern Veracruz about 90 km southeast of Veracruz city (Fig. 1). Within the Sierra is one of the most extensive humid tropical forest areas in Mexico. The region's varied habitats not only provide suitable ecological conditions for many bird migrants (Andrle, 1966) but support an abundance of resident species. This paper deals with the Sierra's nontransient bird species and attempts to analyze briefly their composition and affinities, distribution and abundance, and some aspects of their ecology. Since Sclater's (1857 *a,b*) reports appeared on birds collected near San Andrés Tuxtla and Sontecomapan, and Nelson and Goldman secured specimens in the region in 1894, apparently the only published ornithological studies have been those by Wetmore (1943) on part of the western section, by Davis (1952) on a small area south of Lake Catemaco, and by Edwards and Tashian (1959) on the section about Coyame. My investigations were carried out in short periods in 1951, 1952, and 1960, and during about eleven months residence in 1962.

DESCRIPTION OF THE SIERRA DE TUXTLA

The Sierra is a volcanic range about 4,200 square km in area whose four largest volcanoes culminate an uplift that in most directions slopes gradually to the coastal plain. Exceptions to this are where long ridges form headlands at the Gulf and where Cerros Tuxtla and Blanco, two outlying volcanoes, interrupt the descent to the lowlands (Fig. 2). The northwestern massif, centered on Volcán San Martín Tuxtla, has a surface characterized by medium to small-sized, cratered cones and rounded hills interspersed among ridges, valleys, and undulating terrain. The line of cones extending from Volcán San Martín southeast across the north side of the Lake Catemaco basin merges into the southeastern massif dominated by Volcán Santa Marta. There deep gorges and dissected lava ridges radiate toward the coast, while broad ridges and narrow valleys lead southward from the peaks. The Sierra is a well-watered region with Lake Catemaco lying in a large basin partially bordered by volcanic cones and hills, Bahía Sontecomapan on the Gulf, about ten scattered crater lakes, and many permanent streams.

For study purposes I set the inland border of the Sierra at about the 100 m contour. The more abrupt descent to the Gulf and the general proximity of the range to the coastline make sea level there a practical delimitation for avifaunal analysis.

CLIMATE, VEGETATION, AND LIFE ZONES

The Sierra's climate is influenced by northeast trade and continental winds, northers, occasional easterly waves, and by the moderating effects of the Gulf. Its large volcanoes and their subsidiary cones and ridges form a front about 50 km long that is an orographic barrier to air masses from the Gulf and inland. The resulting orographic precipitation and that from convection give the range a generally humid character, although drier conditions exist in the rain shadow on the inland slopes and along the Gulf. Mean annual precipitation ranges from about 1,700 to over 4,000 mm, the complex topography affecting local amounts and intensity. During the rainy season from May to November and at times in the dry season the mountains above 700 m are often cloud covered. Although the warm Gulf water, persistent cloud cover, and extensive forests contribute toward temperature moderation (mean annual recorded 24.2 C), minimum temperatures, especially during northers, can be fairly low (6–10 C) and freezing does occur infrequently at upper altitudes.

High rainfall and warm temperatures support the development of luxuriant vegetation, much of it comparatively homogeneous humid forest. Yet volcanism and weathering have formed a varied topography that interacts with changes in soil type, depth, and moisture to cause considerable local structural complexity in plant formations. Such variability is increased in much of the Sierra by expanding human modification of vegetation creating seral stages that provide diverse habitats for birds (Fig. 3). Figure 4 shows the general distribution of vegetation types except for restricted areas of tropical semideciduous forest on the inland slopes and lowland valley and swamp forest occupying small sections in stream valleys on the Gulf side.

Rain forest (Fig. 5) occupies a large part of the Sierra and varies in stratification and height with change in altitude and the factors mentioned previously. Although here I designate it as rain forest, in many places its structure is more like Beard's (1944:138) "Evergreen Seasonal Forest" than his optimum rain forest formation. At higher altitudes the humid forest resembles his "Lower Montane Rain Forest," "Montane Rain Forest," and "Elfin Woodland" formations. Some of the canopy tree genera in the Sierra's tall rain forest are *Bernoullia*, *Brosimum*, *Dussia*, *Ficus*, *Ilex*, *Phoebe*, *Pithecollobium*, *Talauma*, and *Virola*. Vines, air plants, climbers, and tree buttressing are conspicuous. Above about 1200 m the transition occurs to a lower forest that becomes elfin and more moss-covered on crater walls and peak ridges (Fig. 6). Miranda and Hernandez (1963), however, classify the tall, humid forest in the Sierra as "selva alta perennifolia," which they equate with Beard's optimum rain forest. The montane types, including cloud forest and the elfin woodland, they designate as "selva mediana o baja perennifolia."

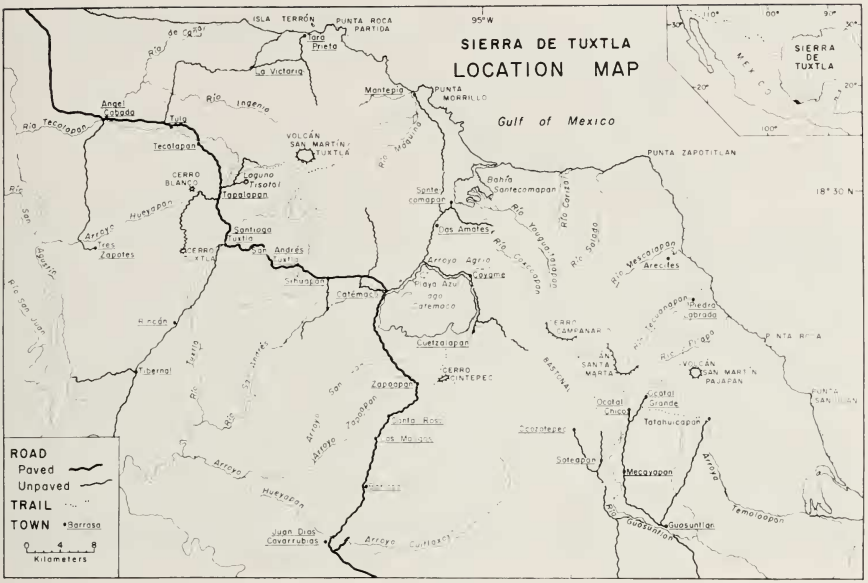

Fig. 1. Drainage system and principal peaks of the Sierra de Tuxtla in relation to roads, trails, and urban centers.

Although there is not sufficient precipitation data available for the Sierra to make a complete analysis of vegetation under the Holdridge (1947) system, probably none of the range's humid forest can be placed in his "Rainforest" formations. Most of this forest should be classified in his "Tropical Moist Forest" category with that at higher altitudes being placed in the "Subtropical Wet" or "Subtropical Moist" formations.

An open, pine and oak woodland with pines (*Pinus oocarpa*) chiefly on the ridges and oaks more on the ravine and valley sides occurs on the southern slopes of the Volcán Santa Marta massif (Fig. 7). Remnants of tropical semideciduous forest ("Selva alta o mediana subcaducifolia" of Miranda and Hernandez) and extensive oak woodlands interspersed with tree savanna lie at lower elevations to the south. Sweet gum (*Liquidambar styraciflua*) occurs sporadically in the humid forests of both massifs and north of the Lake Catemaco basin, but large stands ("bosque caducifolia" of Miranda and Hernandez) exist only on the upper southern slopes of the Volcán Santa Marta section where they merge at their upper edge into montane rain forest. Deforestation has resulted in a great expansion of open country with grasslands and weedy fields broken by tree rows, forest remnants, and occasionally palms or patches of palm forest.

The Sierra de Tuxtla lies entirely within the Tropical Life Zone. The

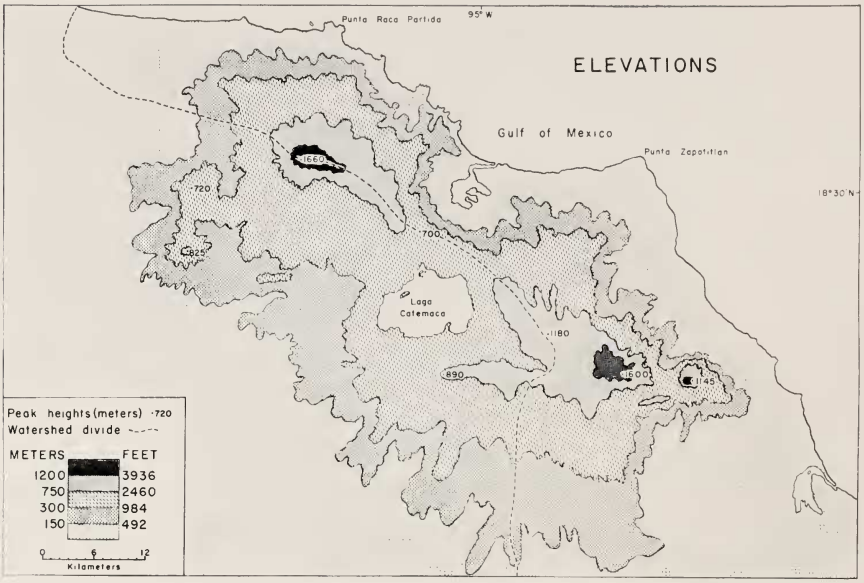

FIG. 2. General elevation pattern of the Sierra de Tuxtla showing key heights.

Humid Upper (Subtropical) and Lower Tropical Zones encompass mostly the rain and cloud forests and some of the nonforested terrain. The Arid Division of the Lower Tropical Zone extends into the Sierra from the inland side, including principally the semi-open palm-forest-grass areas, oak and tropical semideciduous forests, the savannas and some of the pine-oak section. My investigations show that in regard to the avifauna there are no distinct life zone boundaries in the Sierra, and the demarcation between Humid Upper and Lower Tropical Zones is definitely transitional as evidenced by altitudinal mixing of avian forms. The arid part of the Lower Tropical Zone is not strongly indicated by the avifauna, comparatively few species occurring that can be considered typical of this division. From an altitudinal viewpoint the role of temperature in life zone definition here is apparently minimized by the small relief and relatively low latitude of the range.

NONTRANSIENT BIRDS

Historical background, composition, and affinities.—The Sierra de Tuxtla has been available for permanent avian colonization since its final emergence from the sea and uplift during the Pliocene. At this time probably some modern bird genera became well established, and the range's avifauna very likely contained a pronounced tropical element. However, the avifauna's

Fig. 3. Sierra landscape near Cerro Blanco, one which supports many species of habitat B. In the background are forested Volcán San Martín Tuxtla and subsidiary mountains.

composition during the late Tertiary and Pleistocene is necessarily speculative because, like other parts of Mexico and Central America, the Sierra was affected by the faunal mixing of northern and southern elements that possibly increased after closing of the water gaps between North and South America and cooling of the climate in North America in the Pleistocene. Even during lowered temperatures of Pleistocene glacial stages, however, it seems unlikely that the Sierra's climate ever became cooler than warm temperate. From the Eocene to the Pleistocene and in the latter's interglacial stages it was probably tropical (Dorf, 1959:185). Therefore, though tropical vegetation elements may have been less abundant during the Pleistocene, and the Upper Tropical Life Zone probably descended in elevation (see Griscom, 1950:358), it seems certain that the Sierra's avifauna at this time was not completely displaced. When the climate ameliorated after the final glacial stage and humid tropical vegetation was able to attain its present northward extent and abundance, bird species of the Upper Tropical Zone in the Sierra were then restricted to higher altitudes and more suitable conditions were afforded for northward dispersal into the range of Lower Tropical Zone birds from the Central American lowlands. It is probable that the avifauna, for most of the range's history since its volcanic formation, has consisted

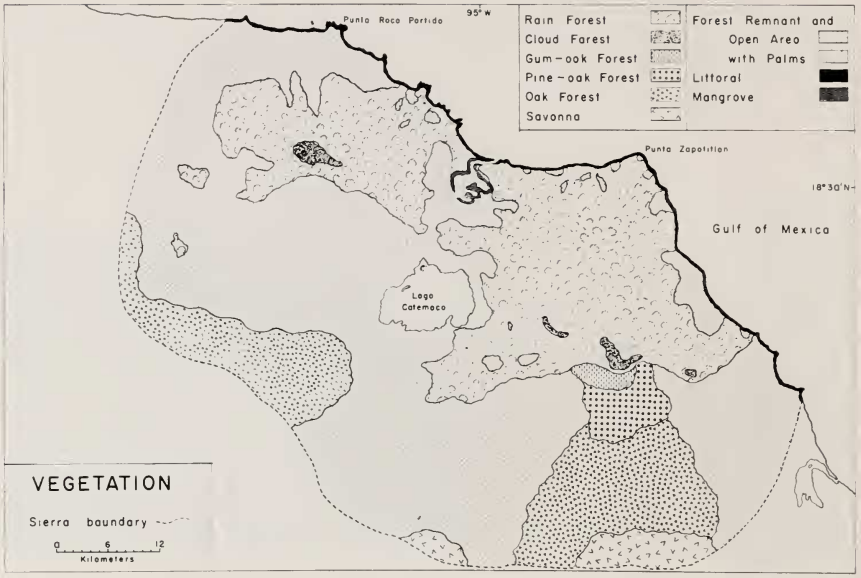

FIG. 4. Principal vegetation types of the Sierra de Tuxtla.

mainly of forest-adapted species. Only in the comparatively short time since it has been occupied by humans has a major transformation occurred to the preponderance of nonforest types evidenced by the present avifaunal composition.

Nontransient species (including those that are known to breed or may possibly do so) recorded in the Sierra de Tuxtla number 251, representing 58 families. Since there are suitable nesting habitats for those not known to breed and their ranges in Mexico either encompass the Sierra or are not far distant, it is probable that some breed at present. The family represented in the Sierra by the largest number of species (26) is the Tyrannidae. The six other families among the highest in number of species are: Accipitridae (13), Columbidae (13), Trochilidae (14), Icteridae (14), Thraupidae (14) and Fringillidae (14). Almost one-third of all the families are represented by only one species each.

On the basis of Mayr's (1946) analysis of the history of the North American bird fauna, the Sierra's nontransient avifauna can be divided into six elements. Species of probable North American and Old World origin total about 67 in contrast to the essentially southern origin of the Panamerican and South American elements, represented by a total of about 111 species. Almost half of the species comprising these last two elements are characteristic of the humid tropical forest which formed a medium for their dispersal

FIG. 5. Interior of montane rain forest along old road at 650 m elevation southeast of La Victoria. Upper Tropical Zone birds, such as *Geotrygon lawrencii*, *Turdus assimilis*, and *Chlorospingus opthalmicus*, are fairly numerous here.

FIG. 6. Crater of Volcán San Martín Tuxtla covered by cloud forest. Relatively few birds inhabit the elfin type predominant here. View is from 1600 m elevation toward northwest where clouds from the Gulf are beginning to move over the range.

northward. The avifauna is also composed of a large number of species (70) in the Widely Distributed and Pantropical elements of unknown or uncertain origin (27 per cent of the nontransients). Apart from these last two elements, however, species of probable Neotropical origin predominate (44 per cent) in the Sierra in comparison to those with northern affinities (26 per cent), reflecting the principally tropical character of this portion of the nontransient avifauna.

Systematic lists by habitat.—The difficulty in relating species to particular habitats is increased by the fact that many are not restricted to one type and that humid and drier areas are not well defined. As an example of this, the Streak-headed Woodcreeper (*Lepidocolaptes souleyetii*) occurs regularly in rain forest but also frequently in tropical semideciduous and oak forest. Some other species regularly found in at least two habitats are the Wedge-tailed Sabrewing (*Campylopterus curvipennis*), Golden-olive Woodpecker (*Piculus rubiginosus*), Pale-billed Woodpecker (*Phloeoceastes guatemalensis*), and Bright-rumped Attila (*Attila spadiceus*). In the following lists I have assigned each species to the major habitat in the Sierra with which it is primarily associated. The House Sparrow (*Passer domesticus*), which in small numbers frequents primarily the large towns, is excluded. The six

FIG. 7. Pine forest on southeast ridges of Volcán Santa Marta at 800 m altitude. Birds are more numerous in adjacent ravines where gum-oak and rain forest occur. In the background is cloud-covered Volcán San Martín Pajapan.

habitats are based on distinctive vegetation formations and associations and upon the existence of water bodies.

Included after each species is an abbreviation indicating its relative observable abundance in the Sierra as a whole based on sight and/or sound record or collecting in its preferred habitat during several hours of field work. Admittedly, attempts to be quantitative in this regard are difficult. However, the following categories (modified from Loetscher, 1941) are based only on the numbers of birds that might be recorded by a competent observer and do not purport to show actual abundance of each species. But I believe that in most cases the category to which a species is assigned fairly closely corresponds with its real abundance.

Abundant (A): over 150 recorded every day
Very common (VC): 75–150 recorded every day
Common (C): 15–75 recorded every day
Fairly common (FC): 5–15 recorded every day
Rather uncommon (RU): 3–8 recorded but not every day
Uncommon (U): 1–5 recorded, but frequently not observed for one or a few days at a time
Very uncommon (VU): 1–5 recorded in one to three months and usually not observed for one to three weeks at a time

Rare (R): less than 10 recorded per year and not recorded at all for varying, sometimes prolonged periods

Very rare (VR): recorded from one to three or four times in the region and likely to occur again.

Altitudinal ranges after each species are in meters above sea level. A hyphen before or after a single elevation or the limits of a species' range indicates that it possibly occurs beyond the altitude(s) given. A dagger following a species name indicates that it occasionally frequents a more humid or drier habitat as the case may be. First records for the Sierra, as here delimited, that have not, to my knowledge, been previously published (55) are marked by an asterisk. Eisenmann (1955) has been followed here and elsewhere in the paper for most species' common and technical names.

Habitat *A*—Tropical rain forest (montane and coastal lowland) and cloud forest—82 species.

Tinamus major U 0–850
Crypturellus soui U 0–800
Crypturellus boucardi FC –250–900
**Chondrohierax uncinatus* VR 300
Accipiter bicolor VR 400
Leucopternis albicollis† RU 0–900
**Spizaetus tyrannus*† VR 0–850
**Micrastur semitorquatus* U 0–1300
**Micrastur ruficollis* RU 500–1500–
Crax rubra RU 0–900
Penelope purpurascens FC 0–1400–
Odontophorus guttatus FC 300–1300
Columba speciosa RU –350–800
Columba nigrirostris FC 0–750
Leptotila verreauxi† C 0–1100
Leptotila plumbeiceps FC 0–750
Geotrygon lawrencii FC 350–1400–
Geotrygon montana RU 0–900–
**Bolborhynchus lineola* VR 800–
Pionopsitta haematotis† R 400–550
Otus guatemalae † U 0–1100
Pulsatrix perspicillata VR 0–
Ciccaba virgata† FC 0–1660
Phaethornis superciliosus FC 0–850
Phaethornis longuemareus RU 0–550
Campylopterus hemileucurus RU 0–1500–
**Colibri thalassinus* U 650–800
**Lampornis amethystinus* VR –1280–
Trogon massena U 0–500
Trogon collaris FC 0–1660
Trogon violaceus† FC 0–1200
Hylomanes momotula R –750
Momotus momota† FC 0–1200
Aulacorhynchus prasinus RU 400–1660
Celeus castaneus VU 0–600
Phloeoceastes guatemalensis† U 0–950
Dendrocincla anabatina VU 0–800
Sittasomus griseicapillus FC –900
Dendrocolaptes certhia U –850
Xiphorhynchus flavigaster† FC 0–1300
Lepidocolaptes souleyetii† RU –800–
Lepidocolaptes affinis U 900–1660
Anabacerthia variegaticeps U 700–1200–
Automolus ochrolaemus FC 0–1400
Xenops minutus U 0–850
Formicarius analis FC 0–950
Grallaria guatimalensis R 0–800–
Pipra mentalis VU 0–850
Empidonax flavescens RU 900–1660
Myiobius sulphureipygius VU 0–600
**Onychorhynchus mexicanus* R 0–650
Platyrinchus mystaceus RU 0–850
Tolmomyias sulphurescens† U 0–750
Rhynchocyclus brevirostris RU 500–1200
Oncostoma cinereigulare VU 0–850
**Ornithion semiflavum* R 0–800–
**Leptopogon amaurocephalus* VR 300
Pipromorpha oleaginea RU –950
Cyanocorax yncas† FC 250–1300
Henicorhina leucostica C 0–1500–
Turdus assimilis C 300–1300–
**Turdus infuscatus* R 1300–1660
Myadestes unicolor FC 400–1660
Catharus mexicanus FC 450–1400–
**Smaragdolanius pulchellus* R 0–800
Hylophilus ochraceiceps RU 0–900

Hylophilus decurtatus FC 0–850
Cyanerpes cyaneus† C 0–950
Parula pitiayumi† FC –150–950
Myioborus miniatus FC 600–1250–
Basileuterus culicivorus C 0–1000
Basileuterus belli U 750–1660
Chlorophonia occipitalis VR 300–750–
**Euphonia gouldi* VU –700–
Piranga leucoptera U 450–1000–
Habia rubica† RU 0–1100
Lanio aurantius VU 0–650
Eucometis penicillata U –650
Chlorospingus opthalmicus FC 500–1660
Caryothraustes poliogaster C 0–850
Cyanocompsa cyanoides RU 0–850
Atlapetes brunneinucha FC 400–1660

Habitat *B*—Humid forest edge, thickets, bush and tree rows and fields in humid areas—93 species.

**Harpagus bidentatus* VR 300
Buteo magnirostris† FC 0–850
Buteo nitidus† RU 0–950
Herpetotheres cachinnans† VU 0–650
Falco albigularis †VU 0–800–
Ortalis vetula† VU 0–1000
Columba flavirostris† C 0–1660
Columbigallina minuta VR –400–
Columbigallina talpacoti C 0–800
Claravis pretiosa U 0–950
Aratinga astec† C 0–750
Amazona autumnalis† C 0–700
**Coccyzus minor* VR 625
Piaya cayana† RU 0–750
Crotophaga sulcirostris† C 0–650
Tapera naevia† VU 0–350
Glaucidium brasilianum† RU 0–750
Nyctibeus griseus† R 0–800
Nyctidromus albicollis† C 0–950
Campylopterus curvipennis FC 0–1200
Anthracothorax prevostii† U 0–650
**Paphosia helenae*† VU 600–
Chlorostilbon canivetii† RU 0–800
Amazilia candida FC 0–1100
Amazilia tzacatl† FC 0–800
**Galbula ruficauda* U 0–50–
Pteroglossus torquatus† RU 0–600
Ramphastos sulfuratus† FC 0–1250
Piculus rubiginosus RU –1660
Centurus aurifrons† C 0–1000–
Centurus pucherani VU 0–800
Veniliornis fumigatus VU 0–800
Synallaxis erythrothorax† FC 0–750
Taraba major VR 0–300
Thamnophilus doliatus† FC 0–850
**Cotinga amabilis* VR 300
Attila spadiceus† RU 0–950
Pachyramphus major† R 0–1250
Platypsaris aglaiae† RU 0–750
Tityra semifasciata† FC 0–1250
**Tityra inquisitor*† VU 0–700–
Tyrannus melancholicus† C 0–950
Legatus leucophaius RU 0–900
Myiodynastes luteiventris† FC 0–950
Myiodynastes maculatus RU 0–750
Megarhynchus pitangua† FC 0–850
Myiozetetes similis† C 0–850
Pitangus sulphuratus† C 0–850
Myiarchus tyrannulus† FC 0–750
Myiarchus tuberculifer† FC 0–1300
Contopus cinereus† U –150–700
Elainea flavogaster† U 0–850
Myiopagis viridicata† VU 0–600
Psilorhinus morio† C 0–800
Campylorhynchus zonatus† FC 0–650
Thryothorus maculipectus† FC 0–1250
Troglodytes musculus U –100–850
Turdus grayi† C 0–950
Ramphocaenus rufiventris† VU 0–850
Cyclarhis gujanensis† U 0–600–
Vireo olivaceus† C 0–1250
Coereba flaveola RU 0–1100
Chamaethlypis poliocephala† FC 0–750
Basileuterus rufifrons FC 0–950–
Zarhynchus wagleri VR –300–
Gymnostinops montezuma FC 0–650
Amblycercus holosericeus† FC 0–600
Psomocolax oryzivorus VU 0–600
Tangavius aeneus† FC 0–700
Cassidix mexicanus† VC 0–800
Dives dives† C 0–700
Icterus prosthemelas† RU 0–750
Icterus wagleri VR 500
**Icterus cucullatus* R 0–
Icterus mesomelas U 0–650
**Euphonia musica* VR 500–850
Euphonia affinis† RU –850
Euphonia lauta† FC 0–850

Thraupis virens† FC 0–750
Thraupis abbas† C 0–850
Phlogothraupis sanguinolenta RU 0–650
Habia gutturalis† FC 0–850
Saltator atriceps† C 0–900
Saltator maximus VU 0–650
Saltator coerulescens† FC 0–750
Richmondena cardinalis† RU 0–850
Cyanocompsa parellina† VU 0–650
Tiaris olivacea† FC 0–750
Sporophila torqueola† C 0–750
Volatinia jacarina† C 0–650–
**Spinus psaltria*† U –200–900
Arremenops rufivirgatus† FC 0–850
Aimophila rufescens† FC 0–950

Habitat *C*—Semideciduous forest and edge, thickets, bush and tree rows and fields in drier areas—20 species.

Crypturellus cinnamomeus† RU 0–800
**Colinus virginianus*† FC 0–800
Zenaida asiatica† R 0–600
Scardafella inca† R 0–450
Columbigallina passerina† VR 350
**Coccyzus americanus* U –100–200
**Rhinoptynx clamator*† VR –150–300
Amazilia yucatanensis† U 0–400
**Heliomaster longirostris*† U 0–800
Trogon citreolus† FC 0–700
Dryocopus lineatus† U 0–700
Dendrocopos scalaris† U 0–700
Pyrocephalus rubinus† VU 0–400
Muscivora tyrannus† VU 0–700
**Camptostoma imberbe*† U 0–400
Uropsila leucogastra† RU 0–600
**Mimus polyglottos* VR 400
**Polioptila caerulea* RU 0–200
Icterus gularis† U 0–700
**Sturnella magna*† VR –250

Habitat *D*—Pine-oak forest (also in other forest types and edge)—4 species.

**Amazilia cyanocephala* FC –500–850–
**Melanerpes formicivorus* C 0–850–
**Parus atricristatus* VU –150–
Icterus chrysater U 0–750–

Habitat *E*—Humid and drier open areas (widely ranging or not assignable to a particular habitat)—14 species.

Sarcoramphus papa VU 0–900
Coragyps atratus VC 0–1660
Cathartes aura RU 0–1660
Elanus leucurus VU 0–750
**Buteo albonotatus* VR –400
**Buteo brachyurus* VR 0–800
Polyborus cheriway RU 0–750
Falco femoralis VU 0–600
**Tyto alba* VU –150–600
**Chordeiles acutipennis* R 0–500
Streptoprocne zonaris FC 0–1000
Chaetura vauxi C 0–1100
Progne chalybea U 0–800
Stelgidopteryx ruficollis FC 0–800

Habitat *F*—Water bodies (associated primarily with lakes, ponds, streams, swamps and marshes)—37 species.

**Podiceps dominicus* C 0–400
Podilymbus podiceps FC 0–400
Pelecanus occidentalis U 0–350
Phalacrocorax olivaceus A 0–400
**Anhinga anhinga* R 0–400
Fregata magnificens FC 0–400
Butorides virescens FC 0–650
**Florida caerulea* U 0–650
**Casmerodius albus* R 0–350
Leucophoyx thula A 0–450
**Bubulcus ibis* U 0–450
**Hydranassa tricolor* VU 0–350
Nycticorax nycticorax FC 0–600
**Nyctanassa violacea* VU 0–350
**Ixobrychus exilis* VR 350
Cochlearius cochlearius VR 350
**Mycteria americana* VR 350
Eudocimus albus VR 0–
**Dendrocygna autumnalis* R 350
Rostrhamus sociabilis RU 0–350
Buteogallus anthracinus RU 0–1100
**Hypomorphnus urubitinga* U 0–800
**Aramus guarauna* VR 0–
**Amaurolimnus concolor* VR 0–
Aramides cajanea R 0–
**Laterallus ruber* VR 350

**Porphyrula martinica* VR 350
**Heliornis fulica* RU 0–
Jacana spinosa FC 0–350
**Charadrius collaris* RU 0
**Charadrius wilsonia* U 0
Ceryle torquata FC 0–350
Chloroceryle amazona U 0–350
Chloroceryle americana RU 0–350
Chloroceryle aenea VU 0–450
Sayornis nigricans U 200–500–
Iridoprocne albilinea FC 0–400

Areal distribution and relative observable abundance.—Of the 82 species listed in habitat A, 16 (19.5 per cent) were found to frequent drier habitats: in contrast, 66 (70.9 per cent) of the 93 species associated with habitat B range at times into drier areas. The low percentage of species inhabiting rain and cloud forest that enter drier habitats indicates the restricted ecological requirements of this portion of the avifauna. A comparison of the species' observable abundance in habitats A and B, the two encompassing most of the Sierra, shows that about 48 per cent of the species in the latter habitat are fairly common to abundant, but only 35 per cent of those in the former type are classed similarly. This contrast is apparent through the range, and, though the actual difference may be offset somewhat by greater difficulty of observation in forest, corresponds with my observations of the relationship in other tropical areas. Often some species of habitat B enter the rain forest or frequent natural or man-made openings, which are numerous in the Sierra. Many species of this habitat are very irregularly distributed. Some, such as the Bronzed Cowbird (*Tangavius aeneus*) and White-collared Seedeater (*Sporophila torqueola*), gather in flocks and may be entirely absent from many suitable sections. In habitat B, as well as in other types where seral communities exist, cutting, burning, and livestock grazing are important factors influencing bird movement and distribution.

Species primarily associated with habitat C seem to be even less abundant than those of habitats A and B, only two of the 20 being classed as fairly common. The Red-billed Azurecrown (*Amazilia cyanocephala*) and Acorn Woodpecker (*Melanerpes formicivorus*) of the pine-oak habitat also range upward to more open ridges near the gum forest and to lower elevations in tropical semideciduous and oak forests. Most of the widely ranging species are not common, but the White-collared Swift (*Streptoprocne zonaris*) and Vaux's Swift (*Chaetura vauxi*) often congregate in flocks (about 10–200 birds) as does the Black Vulture (*Coragyps atratus*) when feeding or sighting food. The largest flock of these vultures I have seen in the Sierra was 220 near Santiago Tuxtla. Many species primarily associated with water bodies also range into forest edge and open country some distance from water. The hawks *Buteogallus anthracinus* and *Hypomorphnus urubitinga* particularly do this. A few small marshes on Lake Catemaco and Bahía Sontecomapan are frequented by members of the Ardeidae and Rallidae. The Brown Pelican (*Pelecanus occidentalis*) and Magnificent Frigatebird (*Fregata magnificens*)

FIG. 8. Air view of Volcán Santa Marta massif from the Gulf side showing large extent of montane forest. Deforestation is progressing upwards in some valleys. This wilderness area and a similar one on the northwestern massif would make excellent parks or natural reserves.

occur inland over the Sierra, especially during northers, and apparently breed at its base in a small colony on Isla Terrón in the Gulf off Punta Roca Partida.

Continuing deforestation and prevention of forest regeneration in many places by new settlements are resulting in considerable expansion in areal range and increase in overall abundance of nonforest species at the expense of forest birds. Yet this trend has apparently not occurred as rapidly as it has in other parts of Veracruz because difficulty of access to parts of the Sierra has permitted much forest habitat to remain essentially undisturbed by man. In this regard the excellent potential of the Sierra as a region where a large national park or rain forest preserve could well be established has been brought out by Shelford (1941), Leopold (1959), and the author in a previous report to the Mexican authorities (Fig. 8).

Altitudinal distribution.—Since the Sierra's relief is small compared to that of most other Mexican mountain ranges, and consequently its vertical temperature gradient (normal lapse rate) not great, it seems that temperature is not an important factor affecting the normal altitudinal ranges of birds. A few species' adaptability permits their vertical ranges to extend over the maximum

relief of the Sierra. Most forms, however, usually occur within smaller elevation limits and are to a considerable degree controlled by the distribution of forest formations and the secondary vegetation modified chiefly by man.

The elevation ranges of species inhabiting rain and cloud forest indicate that almost two-thirds do not normally ascend above about 1,000 m. Species observed regularly above this altitude are those which occur through either the entire altitudinal extent of the Sierra or mainly in the Upper Tropical Zone. The occurrence of some Upper Tropical Zone species, such as the Purplish-backed Quail-Dove (*Geotrygon lawrencii*), Slate-colored Solitaire (*Myadestes unicolor*), and Slate-throated Redstart (*Myioborus miniatus*), commonly below 1,000 m, frequently below 600, and occasionally below 450 in the months of the northern winter and summer indicates their ecological adaptability and reflects the ill-defined nature of the Upper Tropical Zone lower limit in the Sierra. Also, as Wetmore (1943:223–224) pointed out, such species tend to descend lower here than in the mountains of Central America probably because of being affected in the winter and early spring months by lower temperatures brought about by northers usually accompanied by heavy rain.

Since the majority of nontransients normally are found in the Lower Tropical Zone usually well below 1,000 m, the comparative number of birds at higher elevations is greatly restricted. The variety of resident species above this altitude is also curtailed by the presence of only one habitat type, unbroken forest and the fact that only about 10 per cent of the Sierra's land area lies above 750 m. On the inland side of the range deforestation allows species associated with both humid and drier nonforest habitats to ascend to much higher altitudes than is possible on the Gulf slopes. The upper altitudinal limits of some of these species would be even higher if they were not blocked by the forest. The altitude ranges for species in the habitat lists are based on my observations and those of other investigators. They are approximate altitudes within which each species was normally recorded and do not mean that the species does not exceed these limits occasionally. Actually, the normal upper limits of some species, such as the Scaled Antpitta (*Grallaria guatimalensis*), are probably higher than is indicated.

Notes on ecology and breeding.—The observations of Edwards and Tashian (1959:328–330) on the ecology and abundance of birds in rain forest and forest edge around Coyame in the months of June and July are generally similar to my own made in the same habitat types in the Sierra. As expected, however, I found that abundance and habitat preferences of some species vary with the seasons and other factors such as meteorological phenomena and food availability. The presence of flowering plants in forest openings and in forest edge or open areas markedly influenced the local abundance

and distribution of hummingbirds. I found that they were often as abundant in number and variety of species in forest edge and open sections as they were in the forest interior. At no time did I discover any great concentrations at flowers as did Lowery and Dalquest (1951) in the Veracruz lowlands. Although Edwards and Tashian (1959) listed the White-bellied Emerald (*Amazilia candida*), and Yellow-billed Cacique (*Amblycercus holosericeus*) as interior rain forest species, I observed them more frequently in edge, openings, and low, secondary growth. Red-legged Honeycreepers (*Cyanerpes cyaneus*), though often feeding in the tops of trees within the rain forest, frequently forage in forest edge and in open places with scattered large trees. Particularly attractive to them are the orange-red flowers of *Bernoullia flammea*, a large rain forest tree that is sometimes left standing in the open when forest is destroyed. I have counted as many as 70 honeycreepers in the top of one of these trees when it was in bloom in early April.

Fruiting of trees in forest and open areas is a great attraction throughout the year for many species, influencing their local distribution and constituting an important element in the avian ecology of the Sierra. Lowery and Dalquest (1951:635) report the collection of two specimens of the Blue-crowned Chlorophonia (*Chlorophonia occipitalis*) from such a tree (probably *Ficus* species) near San Andrés Tuxtla in January 1948. Several other tanager species, particularly the Yellow-winged Tanager (*Thraupis abbas*), were also feeding there. I have observed Yellow-throated Euphonias (*Euphonia lauta*), Scrub Euphonias (*Euphonia affinis*), Olive-throated Parakeets (*Aratinga astec*), Clay-colored Robins (*Turdus grayi*), White-throated Robins (*Turdus assimilis*), and Montezuma Oropendolas (*Gymnostinops montezuma*) in fairly high numbers in such fruiting trees. Among the many tree species utilized in this regard by the birds are *Ficus costaricana*, *Ficus glabrara*, and *Mirandaceltis monoica*, three in which I have noted especially large concentrations. Such trees not only attract birds from considerable distances and from different habitats but also draw species inhabiting forest understory and low thickets to upper levels where they normally do not occur. Members of the Columbidae especially are attracted when ripe fruits fall to the ground.

Flocks of forest birds occur throughout the year in the Sierra, but there is a marked decrease in this activity in late February and March as more species start to breed. In March many species commence nest building, and in April and early May the breeding cycle reaches a high level in numbers of individuals involved. From mid-May through June young birds out of the nest are very conspicuous. Breeding activity continues through July and August involving lesser numbers of birds, but thereafter a marked decline takes place and more flocking occurs through the months of the northern

fall and winter. I have not observed nesting activity from November through January in the Sierra, but some species may breed then because specimens collected during this period have apparently been in breeding condition. A pronounced breeding season as well as an earlier and more prolonged one than in more northern areas would be expected at the Sierra's latitude (18°30′N). The incubation phase of the cycle seems to be at a maximum in April at a time when rainfall is very low, severe northers have ceased, and average daily temperatures are high.

An increase in vocalization by most species also takes place in March and April: this is especially noteworthy among the Columbidae after mid-April. This vocal period continues into the summer and early fall with lessening intensity until by early November most species have ceased singing and do not call so frequently.

Endemism.—Possibly interchange of Upper Tropical Zone birds between the Sierra and inland mountains took place during the lowered elevation of this Zone in the Pleistocene, since there is no geological evidence that the Sierra was ever connected to other ranges by a highland. The physical isolation of the Sierra by lowlands has apparently been of sufficient duration to permit subspecific differentiation in a few Upper Tropical Zone forms. The five endemic birds that Wetmore (1943:225) recorded from Cerro Tuxtla and Volcán San Martín Tuxtla are *Geotrygon lawrencii carrikeri*, *Campylopterus curvipennis excellens*, *Empidonax flavescens imperturbatus*, *Myioborus miniatus molochinus*, and *Atlapetes brunneinucha apertus* (see Friedmann et al., 1950; Miller et al., 1957). Lowery and Newman (1949:8) later described another, *Chlorospingus opthalmicus wetmorei*, from specimens collected by Wetmore and Carriker. All these forms except *Empidonax flavescens* are well distributed in humid forest through the range. The normal minimum altitudinal limits of four vary from about 300 to 600 m above sea level. The minimum limit of the fifth (*E. flavescens*) is about 900 m, and the sixth (*C. curvipennis*) ranges to sea level.

Despite the relatively low altitudes reached regularly by most of these birds, the ecological isolation and the subspecific differentiation of all except the last mentioned seems to have been assured by their adaptation to high humidity conditions, somewhat cooler temperatures than exist in lowlands, and a montane rain forest environment. Humid and drier forest types in the lowlands on the inland sides of the Sierra differ in structure and plant composition from this montane forest and apparently do not provide suitable habitats for the endemics. Such vegetation conditions have probably existed for a long time and thus have served as an effective isolating barrier.

C. curvipennis excellens has been recorded in lowlands outside the Sierra near Jesús Carranza (Lowery and Dalquest, 1951:583). This is not unex-

pected since it occurs to sea level at the base of the Sierra and moves readily outside forest habitat. It is possible that this hummingbird, after undergoing differentiation in suitable isolating conditions at high altitudes in the Sierra, gradually adapted to nonforest habitats thereby enabling it to extend its range to the lowlands, particularly where more humid conditions exist as in the Coatzacoalcos basin.

Wetmore remarked on the survival of Upper Tropical Zone endemic birds on Volcán San Martín Tuxtla in spite of the recent volcanic activity there. The only disturbances of record in the Sierra are the eruptions on this volcano in the early 16th century, in 1664 and 1793. Apparently these caused only local changes in the vegetation. From my observations and from the nature of similar volcanic action it does not seem likely that disturbances since the development of the range's montane forest have been extensive enough to destroy simultaneously all habitat required by the endemics. The forested ridge north of Lake Catemaco provides a route for passage between the massifs and may have been a factor in the endemics' survival during periods of volcanic activity.

The existence of a pine area in the Sierra, isolated by almost 250 km from any similar habitat, suggests the possibility of endemism in its characteristic birds. However, none has been discovered so far, and the probable fairly recent development of this vegetation plus the fact that species typical of it are known to range into other habitat types and down to sea level would seem to minimize the chance of this occurring.

NOTES ON SELECTED SPECIES

Least Grebe (*Podiceps dominicus*).—This grebe occurs usually in small numbers on Lake Catemaco, Bahía Sontecomapan, and occasionally on small crater lakes. Since few are seen in summer, most individuals probably go elsewhere to breed where nesting habitat is better. On 27 March 1960, I counted 40 birds on the west side of Lake Catemaco. The maximum I recorded was about 300 on Laguna Tisatal on 31 March 1962, their abundance at this time suggesting a general movement through the region.

Pied-billed Grebe (*Podilymbus podiceps*).—This species is generally less numerous than *P. dominicus*, except at times in the summer months. It frequents the same water bodies. I found no evidence of nesting, but during late May and June there was considerable calling and vigorous pursuit among the group near Playa Azul on Lake Catemaco.

Olivaceous Cormorant (*Phalacrocorax olivaceus*).—Several searches about Lake Catemaco revealed no sign of these cormorants breeding. Local people said they do not breed there, and I suspect that the large numbers often present are attracted only by the abundance of small fish in the lake. The maximum number I observed on Lake Catemaco was about 350 on 10 June 1962, but since this count covered only part of the lake, I judge there were many more present.

Green Heron (*Butorides virescens*).—At least a dozen birds frequented the west shore of Lake Catemaco, and I noted others at various shore points and near Catemaco on the Río San Andrés where a dam forms a pond near the lake outlet. On 24 March 1960,

a pair were building a nest high in a large tree on the Lake Catemaco shore at Playa Azul, and they appeared to be incubating in April. I discovered several dead young and some broken eggs in this area in early April 1962, at which time the herons were also nesting on the Río San Andrés. Nearly full grown young were at Playa Azul on 14 April and in early May.

Snowy Egret (*Leucophoyx thula*).—Many inhabit the shores and islands of Lake Catemaco through the year, and small flocks sometimes forage in fields nearby. Some breed on Isla Tenaspi on the northwest side of the lake where I saw about 350 birds, several nests, and about a dozen almost full grown young on 10 June 1962.

Cattle Egret (*Bubulcus ibis*).—Flocks occur in the winter and spring months in fields near Lake Catemaco and Bahía Sontecomapan and occasionally elsewhere. Normally they are composed of less than 50 birds; however, on 17 February 1962, there were about 150 near Cerro Mono Blanco. In the past several years they have increased in frequency of occurrence and numbers in and near the Sierra.

Least Bittern (*Ixobrychus exilis*).—I observed three in the marsh at the Arroyo Agrio on the north side of Lake Catemaco on 10 June 1962. Dickerman saw one to four birds there in July and August 1963, and collected two on 9 August. They probably breed in this place.

Hook-billed Kite (*Chondrohierax uncinatus*).—I found this species only in the lowlands near Tres Zapotes, but A. Ramírez, collecting for Phillips, secured a male near Dos Amates on 5 December 1961.

Double-toothed Kite (*Harpagus bidentatus*).—The only record is a bird closely observed by Axtell and the author at 350 m altitude in the edge of rain forest above Dos Amates on 17 March 1960.

Bicolored Hawk (*Accipiter bicolor*).—The only records of this apparently rare hawk are by Edwards and Tashian (1959:328) near Coyame in the summer of 1954, and by Ramírez near Dos Amates (imm. collected) in late 1962.

Zone-tailed Hawk (*Buteo albonotatus*).—I observed one as it perched in a small tree on Cerro Blanco at 400 m elevation on 20 September 1962. Three hawks soaring over the forest west of Coxcoapan on 28 March 1962, were very probably this species.

Short-tailed Hawk (*Buteo brachyurus*).—Phillips and I saw a dark phase individual over the northwest shore of Lake Catemaco on 11 October 1962, and I noted a light phase bird above Ocotal Chico on 25 October 1962. Dickerman reported a dark and possibly a light phase bird on 12 and 16 August 1963 north-northeast of Sontecomapan. There seems to be an autumn movement of this species over the Sierra and adjacent lowlands.

White Hawk (*Leucopternis albicollis*).—On 12 April 1960, one was seen carrying a small snake over the forest near Dos Amates. It repeatedly gave a hoarse scream somewhat like that of a Red-tailed Hawk but less sharp and not as loud. A female I collected at 520 m on Cerro Cintepec on 24 September 1962, had an ovary measuring 13 mm. This hawk also frequents semideciduous forest on the inland slope of the Sierra.

Black Hawk-Eagle (*Spizaetus tyrannus*).—One was reported by Dickerman on 18 August 1962, in the primary forest below the Cumbres de Bastonal at about 800 m elevation. Another, also in heavy forest, was seen by Phillips, Dickerman, and the author on Cerro Cintepec on 18 October 1962, at about 600 m. One bird I observed at the inland base of the Sierra in November repeatedly emitted a loud, harsh scream.

Barred Forest-Falcon (*Micrastur ruficollis*).—This falcon was almost always encountered in heavy humid forest and could sometimes be decoyed by squeaking or call imitation. An immature female secured on 21 April 1962, about 5 km southwest

of Sontecomapan, was in breeding condition with one egg well developed and brood patch conspicuous. A male taken in the same locality at 500 m on 4 May had the remains of a small passerine in its stomach. A female with an 11 mm ovary was secured in the same place on 3 December 1962. I also found *M. semitorquatus* in widespread places in the Sierra and it also could be decoyed. A male with testes 15 and 13 mm was collected on 15 August 1962, near sea level at the Río Carizal. The call of the larger species is a loud, somewhat prolonged *aarr* slurred downward with a woodwind instrument quality. That of *M. ruficollis* is a loud *ark*, also slurred downward but shorter, with less volume and a higher pitch than the call of the other species.

Uniform Crake (*Amaurolimnus concolor*).—The only record of this rare rail is an adult male with testes enlarged collected in Bahía Sontecomapan on 15 February 1963, by Ramírez.

Red Rail (*Laterallus ruber*).—This rail was reported by Dickerman to have been heard calling at Arroyo Agrio marsh between 22 July and 9 August, and again on 3 September 1963.

Purple Gallinule (*Porphyrula martinica*).—Two were feeding in a field at the edge of the Arroyo Agrio marsh on 11 June 1962. Dickerman reported one at this place on 9 August and 3 September 1963.

Scaled Pigeon (*Columba speciosa*).—I collected a male with testes 15 and 14 mm on 25 April 1962, in the rain forest north of Volcán San Martín Tuxtla at 670 m. The crop contained fruits of the tree *Pseudolmedia oxyphyllaria.* This pigeon's call is a fairly loud *hoo-óo-hoo* with a slight but characteristic resonant or bugle-like quality. I found this species in scattered places through rain forest but never more than one or two birds at a time. Davis (1952:315) reported 30 to 40 daily from 11 to 17 June in a coffee plantation south of Lake Catemaco.

Common Ground-Dove (*Columbigallina passerina*).—The only Sierra record is that reported by Sclater (1857*a*:205) from San Andrés Tuxtla.

Purplish-backed Quail-Dove (*Geotrygon lawrencii*).—This endemic dove is fairly common in rain forest through the Sierra, inhabiting principally the ground and understory. Its call is distinctive—a fairly soft, low-pitched *who whó-oo*, the first part of the second note more emphatic and the last syllable slurred downward. Dickerman found a nest on 11 October 1962, about 5 km southwest of Sontecomapan at 500 m altitude. It was on a hillside in secondary forest about 2.7 m above a trail. The nest was a loose but intertwined platform on vines and twigs supported by several crossed and slanted, long bamboo shoots. Its one egg was a plain, pale pinkish color. I usually found these doves singly or in pairs and they often could be decoyed by call imitations. At such times they would come walking rapidly on the ground and sometimes fly up to a low branch. I secured a male in breeding condition on 19 April 1960, about 4 km southwest of Sontecomapan at 500 m. On 1 October 1962, an immature female with ovary 12 mm was taken in the same area.

Barred Parakeet (*Bolborhynchus lineola*).—The only records are five birds reported by Phillips above Ocotal Chico on 7 December 1962, and one on 11 December in the same area.

Brown-hooded Parrot (*Pionopsitta haematotis*).—This species apparently is rare and has been reported only by Davis (1952:315) south of Lake Catemaco and Edwards and Tashian (1959:328) near Coyame. Parrots appear to be generally uncommon in the Sierra. The largest numbers (*Amazona autumnalis*) occur on the north side of the Catemaco basin and about Sontecomapan. Phillips reported seeing at least three parrots south of Soteapan that probably were *Amazona ochrocephala.*

Yellow-billed Cuckoo (*Coccyzus americanus*).—I observed several birds in the oak and tropical semideciduous forest on the southern side of the range on 16 and 17 June and 3 July 1962. A female collected on 17 June near Barrosa had the ovary slightly enlarged. Possibly the species nests in this part of the Sierra.

Mangrove Cuckoo (*Coccyzus minor*).—The only record is a bird I observed on 6 June 1962, at 625 m in thickets among cornfields about 8 km north of San Andrés Tuxtla.

Spectacled Owl (*Pulsatrix perspicillata*).—The only record is from Sontecomapan reported by Sclater (1857*b*:227).

Striped Owl (*Rhinoptynx clamator*).—I collected a female in open, semideciduous forest at Barrosa on 16 June 1962. Its stomach contained remains of a small rodent and a large grasshopper as well as small pieces of coarse grass. A female and two young were reported by Phillips to have been collected by Ramírez near Dos Amates in early 1963.

Green Violetear (*Colibri thalassinus*).—I found this species only in the montane rain forest on the south slope of Volcán San Martín Tuxtla between 650 and 800 m and collected a pair on 4 and 6 June 1962.

Black-crested Coquette (*Paphosia helenae*).—These hummingbirds were seen only in pine forest and adjacent humid montane forest in the Ocotal area where I collected two males on 16 May and 23 October 1962, and Phillips collected three females in December 1962.

Red-billed Azurecrown (*Amazilia cyanocephala*).—Although I found this species only in the Volcán Santa Marta massif above about 500 m mostly in pines, the fact that it occurs in other habitats may account for the five specimens taken by Lamb presumably on the northwest side of Lake Catemaco from 29 July to 2 August 1953.

Amethyst-throated Hummingbird (*Lampornis amethystinus*).—The only record is a female with ovary 3 mm that I secured in the rain forest on Volcán San Martín Tuxtla at 1,280 m elevation on 26 August 1962.

Rufous-tailed Jacamar (*Galbula ruficauda*).—I observed this species only near the Río Carizal not far from the coast, but I expect that it also occurs in low numbers at other places on the lower Gulf slopes.

Great Antshrike (*Taraba major*).—The only records are those by Sclater (1857*a*:203) from Sontecomapan and Ramírez, who collected a pair near Dos Amates in late December 1962.

Lovely Cotinga (*Cotinga amabilis*).—Phillips reported that Ramírez collected an adult and an immature on 7 and 8 January 1961, near Dos Amates, the only records I know of for the Sierra.

Brown-crested Flycatcher (*Myiarchus tyrannulus*).—On 13 April 1962, a pair were investigating a hollow about 3.5 m above ground in the end of a broken limb of a large tree on the lake shore at Playa Azul. They were apparently incubating in early May and on 13 May were carrying food to young in the nest. Four young were being fed out of the nest on 27 May.

Sepia-capped Flycatcher (*Leptopogon amaurocephalus*).—The only record of this rare flycatcher is a female secured by Ramírez at Dos Amates on 4 December 1961.

Southern House Wren (*Troglodytes musculus*).—Although the Mexican Check-List does not record this wren for Veracruz, it is to be expected in the southern part of the state. Edwards and Tashian observed it about one-third of the time in their 1954 field work. I found it uncommon in semi-open areas in widespread parts of the Sierra where it often frequents slash-burned sections in which stumps and fallen trees provide cover.

Common Mockingbird (*Mimus polyglottos*).—The only mockingbird I observed in

the Sierra was one at Playa Azul on 2 April 1960, during a norther. It was a typical individual of this species.

White-throated Robin (*Turdus assimilis*).—On 5 June 1962, I discovered a nest in the understory of montane rain forest on Volcán San Martín Tuxtla at 750 m elevation. It was constructed of green moss, supported by a vine and small branches, and situated about 3.5 m above ground against the trunk of a tree 30 cm DBH. I could not determine its contents. At the time robins were feeding two-thirds grown young in the rain forest as were Ivory-billed Woodcreepers (*Xiphorhynchus flavigaster*), Red-legged Honeycreepers (*Cyanerpes cyaneus*), and Chestnut-capped Brush-Finches (*Atlapetes brunneinucha*). In July *T. assimilis* was the most common species I noted in this rain forest on the volcano. It is of interest that Skutch (1960:85) could find no published record of the nesting of this species in Central America, and the seven nests that he observed were apparently not in forest habitat.

Black Robin (*Turdus infuscatus*).—I collected a male with testes each 3.5 mm in elfin forest at 1600 m on Volcán San Martín Tuxtla on 26 August 1962. Another bird, possibly the female, was calling and exhibiting alarm in the same place. Two others were seen at slightly lower elevations. The small areas of cloud forest in the Sierra limit the available habitat for this species.

Tropical Parula Warbler (*Parula pitiayumi*).—This warbler is a widespread resident in humid and drier forests. I collected a singing male in breeding condition near Barrosa on 16 June 1962. These warblers habitually sing late into the morning and often in the afternoon on hot days when most species are quiet. The Mexican Check-list (Miller et al., 1957:243–244) records the species as only casual in northeast Oaxaca and central and southern Veracruz.

Golden-crowned Warbler (*Basileuterus culicivorus*).—I found a nest at 730 m in the forest on Valcán San Martín Tuxtla on 5 June 1962. It was on the ground in an open section of the forest among leaves and low herbaceous plants. Construction was of leaves, grasses, and rootlets in a dome shape with the interior 7.5 cm in diameter and lined with fine rootlets. The three eggs were pinkish-white with reddish-brown flecks over the entire surface but concentrated in a ring near the large end. One measured 18 by 13 mm.

Chestnut-headed Oropendola (*Zarhynchus wagleri*).—Sclater (1857*b*:228) reported this species from San Andrés Tuxtla, and Ramírez collected a female and male at Dos Amates on 14 and 23 November 1961. Apparently the species is very rare and local in the Sierra.

Wagler's Oriole (*Icterus wagleri*).—Davis (1952:315) reported this species south of Lake Catemaco in 1952, the only record. Although the Mexican Check-List does not list this oriole for Veracruz, it seems likely that it would occur there in highlands in view of its known overall distribution.

Hooded Oriole (*Icterus cucullatus*).—Dickerman reported four birds north of Sontecomapan on 7 August 1962, the only record for the Sierra.

Blue-hooded Euphonia (*Euphonia musica*).—On 22 March 1960, I observed a pair above Dos Amates, saw a male on 20 March 1962, above Colonia Huatusco, and another individual on 30 October 1962, above Ocotal Chico. Phillips reported about eight and collected a male above Ocotal Chico on 8 December 1962. Another was taken by Ramírez near Dos Amates on 6 November 1963. Since the Mexican Check-List (Miller et al., 1957:298) lists the species only from La Joya in Veracruz, apparently these are the first records outside the west-central mountains of the state.

Yellow-throated Euphonia (*Euphonia lauta*).—On 2 May 1962, I discovered a nest

along the Lake Catemaco shore at Playa Azul, 2 m above ground on the underside of a large, horizontal tree limb. It was supported by a large, pendent herb and was oval in shape, 17.7 cm in maximum outside diameter with a 5 cm diameter entrance on the side. The nest was thin and loosely woven of rootlets, fine twigs, and a few grasses and contained four young two or three days old. Two of these were being fed out of the nest on 22 May. This nest was considerably larger than the only one for which Skutch (1954:248) gives measurements. He remarks on the variety of nest sites chosen by this tanager, mentioning fence post tops, palm frond, and holes in earth banks.

Red-crowned Ant-Tanager (*Habia rubica*).—I found a semi-pensile nest in heavy forest above Dos Amates at about 500 m altitude on 5 May 1962. It was 2 m above ground in the fork of a sapling in open understory and was constructed of grasses, rootlets, and small twigs with exterior dimensions of 10.2 by 12.7 cm. The four eggs were white with faint brown flecks more concentrated and pronounced at the large end where they formed a wreath. One measured 25 by 18 mm. It is of interest that neither Skutch (1954) nor Willis (1961) reported more than three eggs in the 20 nests of this species they observed. The female was still incubating in this nest on 8 May and four young about four or five days old were in it on 20 May.

SUMMARY

The Sierra de Tuxtla is a small, comparatively low mountain range in southern Veracruz whose rich avifauna heretofore has been investigated only in restricted areas. This paper deals with the status of nontransient birds in the entire range, covering about 4,200 square km, and lists 251 species known to have been recorded, including 55 not previously reported.

The Sierra's topography of volcanic cones, ridges, gorges, and valleys provides a varied physical base to interact with climatic elements, chief of which are trade and continental winds and northers. An important aspect of the climate is the orographic rainfall resulting from the barrier formed by the four major volcanoes and subsidiary peaks. Precipitation ranges from about 1,700 to over 4,000 mm annually, being greatest on the Gulf slopes. Although temperatures occasionally reach the freezing point at high elevations, the climate is moderated by warm Gulf water, frequent clouds on the mountains, and extensive forests.

A diverse plant cover exists owing partly to vegetation destruction and modification by man over more than half the range. Fertile volcanic soils contribute toward a more homogeneous vegetation typified by rain forest; this comprises one of the two most extensive habitats and supports much of the avifauna. Also supporting important numbers of species are large nonforested sections and water bodies, chiefly Lake Catemaco and Bahía Sontecomapan.

The Sierra lies entirely in the Tropical Life Zone with Humid Upper Tropical and Arid divisions present, the former restricted to higher parts of the mountains and the latter to inland slopes. Boundaries of these zones are ill-defined with respect to avifaunal distribution.

Faunal mixing probably occurred in the Sierra during its history so that avian forms of both northern and southern affinities were represented. Since its climate was probably never cooler than warm temperate, even during the Pleistocene, it is unlikely that bird life in the range was ever completely displaced. Shifting of tropical and northern vegetation elements caused by climatic changes also affected the avifauna. This is now composed of a large number of species in Widely Distributed and Pantropical elements

of unknown or uncertain origin, but apart from this, species of probable southern origin predominate in comparison to those with northern affinities. The Tyrannidae, with 26 members, and six other families with 13 or 14 members each, comprise almost half of the avifauna.

Six major avian habitats are outlined. Lists are given of the species primarily associated with each including estimates of their relative observable abundance and aproximate elevation ranges. Continuing deforestation is resulting in areal expansion and increase in total numbers of nonforest species at the expense of forest birds. The distribution and nature of plant formations largely governs altitudinal ranges of many species, and the majority normally occur below 1,000 m. Among factors influencing abundance and distribution of birds are human alterations of plant cover and flowering and fruiting of plants. The long breeding season, though having a peak period of activity, is expectedly less well defined and more prolonged than those in more northern latitudes.

Differentiation of the few endemic bird species was assured in the Sierra by physical and ecological isolation. Their survival despite volcanic action was possibly aided by dispersal in both massifs and probably permitted by the restricted nature of volcanic disturbances.

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